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published in
Journal of Sports Sciences
2017

DOI (link to publisher)
10.1080/02640414.2016.1189588

citation for published version (APA)
Mann, D. L., & van Ginneken, P. (2017). Age-ordered shirt numbering reduces the selection bias associated with the relative age effect. *Journal of Sports Sciences*, *35*(8), 784-790. https://doi.org/10.1080/02640414.2016.1189588

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Journal of Sports Sciences

ISSN: 0264-0414 (Print) 1466-447X (Online) Journal homepage: http://www.tandfonline.com/loi/rjsp20

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To cite this article: David L. Mann & Pleun J. M. A. van Ginneken (2017) Age-ordered shirt numbering reduces the selection bias associated with the relative age effect, Journal of Sports Sciences, 35:8, 784-790, DOI: 10.1080/02640414.2016.1189588

To link to this article: http://dx.doi.org/10.1080/02640414.2016.1189588

JOURNAL OF SPORTS SCIENCES, 2017
VOL. 35, NO. 8, 784–790
http://dx.doi.org/10.1080/02640414.2016.1189588

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ABSTRACT

When placed into age groups for junior sporting competition, the relative differences in age between children leads to a bias in who is evaluated as being talented. While the impact of this *relative age effect* (RAE) is clear, until now there has been no evidence to show how to reduce it. The aim of this study was to determine whether the selection bias associated with the RAE could be reduced. Talent scouts from an elite football club watched junior games and ranked players on the basis of their potential. Scouts were allocated to one of three groups provided with contrasting information about the age of the players: (1) no age information, (2) players' birthdates or (3) knowledge that the numbers on the playing shirts corresponded to the relative age of the players. Results revealed a significant selection bias for the scouts in the no-age information group, and that bias remained when scouts knew the players' dates-of-birth. Strikingly though, the selection bias was eliminated when scouts watched the games knowing the shirt numbers corresponded to the relative ages of the players. The selection bias associated with the RAE can be reduced if information about age is presented appropriately.

ARTICLE HISTORY
Accepted 10 May 2016

KEYWORDS
Expertise; talent identification; talent development; sports; football

Introduction

The common practice of placing children into age groups for junior sporting competition leads to an unintentional bias in those who experience long-term success. Age groups are designed to ensure that children compete against others who possess similar levels of skill and maturation (most frequently using single-year age-groups, e.g., Under-11s). However, even within those groups there is a difference in the ages of the children, with those born at the start of the selection year competing against others who can be up to 1 year younger. These age differences lead to a *relative age effect* (RAE) that confers advantages to those who are relatively older (Barnsley, Thompson, & Barnsley, 1985; Dudink, 1994) and leads to the increased drop-out of younger players who are disadvantaged as a result of the age grouping (Helsen, Starkes, & Van Winckel, 1998; Lemez, Baker, Horton, Wattie, & Weir, 2014). Ultimately, the advantages conferred during childhood lead to an over-representation of "relatively older" players (born closer to the junior cut-off date) even in elite *adult* teams, long after the advantages during childhood have diminished (Cobley, Baker, Wattie, & McKenna, 2009).

A complex interaction of direct and indirect causes contributes to the RAE experienced in junior sport (for extensive reviews see Cobley et al., 2009; Hancock, Adler, & Côté, 2013; Wattie, Cobley, & Baker, 2008; Wattie, Schorer, & Baker, 2015). Direct effects come about due to dissimilarities in maturation, including differences in size, fitness, muscle mass, strength and cognitive development, providing potential performance advantages to those children who are more mature (Beunen, Ostyn, Simons, Renson, & Van Gerven, 1981; Katzmarzyk, Malina, & Beunen, 1997). This can lead to an over-representation of relatively older children even at the grass roots level of sport participation (Delorme, Boiché, & Raspaud, 2010). But the *indirect* benefits of earlier maturation can be profound, largely due to the evaluations and reactions of others. The physical characteristics associated with early maturation can hold what Sherar, Cumming, Eisenmann, Baxter-Jones, and Malina (2010) term *social stimulus* value that alter the way the child is treated by their peers and family, often influencing the confidence and self-esteem of the child. Crucially, the social stimulus benefits also extend to the behaviour of coaches and scouts in junior sport. Perhaps the most pervasive effect is the bias to identify relatively older or more biologically mature children as being "talented", rather than attributing their better performance to maturation (the *maturation-selection hypothesis*, e.g., Cobley et al., 2009). This can lead to differences in the way that coaches support and encourage young athletes (Cumming, Eisenmann, Smoll, Smith, & Malina, 2005) and, significantly, can result in the relatively older or more mature children being selected into teams, providing access to better coaching, facilities and competition (Furley & Memmert, 2016; Helsen et al., 2012; Wattie et al., 2008), perpetuating the direct advantages they already enjoy. Ironically though this may represent a significant failure from the perspective of talent identification, because in the long run, it may be the relatively *younger* players who are more likely to be successful. Younger children must consistently overcome higher levels of challenge when training against older

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children, and this can lead to longer term advantages, with latter-born children sometimes found to be more likely to receive a full senior contract (McCarthy & Collins, 2014; McCarthy, Collins, & Court, 2015), less likely to be injured (Wattie et al., 2007) and more likely to earn a higher salary (Ashworth & Heyndels, 2007; though see; Furley, Memmert, & Weigelt, 2016). Taken together, the over-selection of relatively older children leads not only to a bias against the younger children, but in doing so may also represent a substantial failure in talent identification on the part of sporting teams and organisations.

Despite the wealth of research demonstrating the impact of RAEs at junior and senior levels of competition (Cobley et al., 2009), almost nothing has been done to demonstrate how to *overcome* these effects (Wattie et al., 2015). This is a particular problem in team sports where the indirect benefits of being older are widespread, because talent identification requires scouts or coaches to make subjective judgments of talent that are likely to be influenced by relative age (e.g., soccer, hockey and rugby, as opposed to objective measures such as time ran or distance jumped that can be used in individual sports, see Romann & Cobley, 2015). A number of practical suggestions have been put forward as possible interventions to minimise the selection-induced RAE in team sports, for instance by: rotating the age cut-off date for junior competition; altering the bandwidth of the age-groups; implementing quotas so that selected teams have an even representation of children of all birth-months; and grouping players according to their weight or height rather than age (Barnsley, Thompson, & Legault, 1992; Cobley et al., 2009; Helsen et al., 2012, 1998; Musch & Grondin, 2001). However, the utility of these modifications remains largely untested, primarily because they require sporting organisations to make significant changes to competition structure. Therefore, a more simple approach is desirable.

One possible approach for reducing RAEs when selecting talent is to simply ensure that those making the selections are aware of the effect so that they can take the age of the players into account when selections are made. However, it is unclear whether doing so is likely to work. Helsen et al. (2012) have recently shown that despite the marked increase in general awareness of the RAE over the last 10–15 years, there has been no reduction in the magnitude of the RAE at the elite level of football. It may be that the RAE is so pervasive that the selection bias remains even if coaches or talent scouts are aware of the effect. Indeed, most scouts would have access to the *dates-of-birth* of the players they are selecting from, and intuitively one might expect that those dates could be taken into account to reduce the bias. However, it is unknown whether those responsible for talent identification do so, or whether a more deliberate approach may be required to account for the age of players when making selections. One possible approach would be to employ *age-ordered shirt numbering*, whereby the numbers on the players' shirts would be ordered to correspond to the relative age of each player (so the oldest would wear number one through to the youngest wearing the highest number). This approach may offer advantages by very explicitly conveying the relative ages of the players while the game is being played.

The aim of this study was to determine whether the selection bias associated with the RAE could be reduced when those selecting talent are provided with information about the age of players they are selecting from. Talent scouts from an elite football club watched video footage of junior football games and ranked the players on the basis of their potential in the game. To determine the impact of access to information about the age of the players, the scouts were allocated to one of three groups that differed in the nature of the information they were provided about the relative ages of the players (viz., no information, dates-of-birth or age-ordered shirt numbering). We expected to find an age-related bias in the selections of those scouts who did not have access to information about the age of the players. If access to information about the relative age of players does help to moderate the impact of the RAE, then we expected to find a reduction in the selection bias of the scouts in the groups who receive information about age. Specifically, we expected that age-ordered shirt numbering would lead to the greatest reduction in selection bias because it would present age-specific information in a simple format that scouts could use when making judgements about talent.

Method

Participants

A total of 25 male talent scouts ($M_{age} \pm SD = 56.0 \pm 10.8$ years) from PSV Eindhoven football club took part in the experiment ($M \pm SD = 9.3 \pm 6.6$ years experience as a scout). PSV is one of the best football clubs in the Netherlands, with their first division team being the highest ranked team in the country at the time of testing. The invitation to scouts explicitly stated that they would be taking part in a study examining the birthdate effect in talent selection. Participants provided written informed consent to a procedure that conformed to the Declaration of Helsinki and was approved by the Vrije Universiteit Amsterdam Faculty of Human Movement Sciences Ethics committee (approval number ECB 2015-15).

Apparatus and stimuli

Two small-sided football matches were filmed for use as video stimuli. In each match, players eligible to compete in Under-11 age competition played on a modified football field (30-m long × 20-m wide). Footage was recorded from an elevated position 6 m above the ground behind one of the goals (GoPro Hero 3 camera, GoPro Inc., USA). Each match lasted approximately 20 min, with teams swapping direction after 10 min.

In Match A, eight children played a four-against-four match without goalkeepers (modified goals, 3.06 × 1.00 m). Players were chosen from a single team that played in an area of the Netherlands that ensured the scouts were unlikely to be familiar with the players. The eight children who took part in the match were invited to take part on the basis of their birthdate to ensure that there were two players born in each of the four quartiles of the year (Jan–Mar, Apr–Jun, Jul–Sep, Oct–Dec; all children were born in the same calendar year, 2004). In some cases, there were more than two players born in the same quartile who were available to be invited to take part; in those cases, the two players invited were selected at random. The individual teams shown in the video footage comprised of one player from each of the quartiles. Players wore coloured bibs to identify their team, but importantly the playing number (1–8) corresponded to the player's relative age: the oldest player wore number one through to the youngest wearing eight. Players were not aware that the numbers corresponded to their age.

In Match B, players from a visiting overseas football academy were filmed. We intended to again record footage of a four-against-four match; however, unexpectedly an extra player not on the attendance list was present. As a result, some minor modifications were made. A five-on-five match was filmed (regulation-sized goals, 5 × 2 m) with one player acting as a goalkeeper and their coach playing as the other goalkeeper. This was unlikely to influence the outcomes of the research, as we were only interested in the evaluation of the performance of the field players (and not the goalkeepers). All children were eligible to compete at the Under-11 age level, but in this case the distribution of birthdates was not controlled: four players were born in the first quartile (two allocated to each of Team A and B), three in the second quartile (two to A and one to B), and one in the fourth quartile (Team B). Clearly the make-up of the academy itself was influenced by the RAE. Players again wore team bibs but in this case numbers 9–16 were allocated a priori. The player not on the attendance list was therefore on the day allocated number 25 (the only remaining number), though he was actually born in the first quartile (between the players with numbers 11 and 12). The goalkeeper wore number 12.

Procedure

All scouts viewed the video footage contemporaneously at the junior headquarters of PSV football club. The task for scouts was to rank the eight field players in each match from one to eight according to their potential as a footballer. Scouts assessed the *potential* of players as this was assumed to be their everyday role: to assess the potential a player has to become a skilled/professional footballer in the future.

Prior to viewing the video footage, scouts were divided into three groups: (1) a *no-age* group (n = 9) who did not know the ages of the players (scouts were given a sheet of paper that contained presumably irrelevant information including the players' name, shirt number, passport number, passport expiration date and nationality); (2) a *date-of-birth* group (n = 8) who received each player's birthdate (in addition to the information provided to the no-age group) and (3) an *age-ordered shirt numbering* group (n = 8) who were told that the shirt numbers of the players corresponded to their age (in addition to being given the same information provided to the date-of-birth group). Semi-random group allocation was used, with the Head of Youth Scouting allocating scouts to groups to ensure that the years of scouting experience was matched across the groups. The perceived skill level of the scouts was not taken into account for group allocation.

The task was explained to the groups separately, after which the scouts moved into the same room and collectively watched the video footage projected on a screen (2.0 × 1.5 m). Match B was shown first to decrease the likelihood of scouts in the no-age and date-of-birth groups detecting the meaning of the shirt numbering. The scouts in the age-ordered shirt-numbering group were told that the player wearing shirt number 25 in Match B should actually be wearing number 11.5 (as his date of birth was in between those for the players wearing numbers 11 and 12). After viewing the match, scouts ranked on a piece of paper the potential of the players from the child with the most to least potential (1–8). The goalkeepers were not assessed. Match A was shown after a short break and again after the match the scouts ranked the players in the same manner. Scouts were allowed to make notes while watching the videos (minimising recall errors), but they were not allowed to communicate with each other when watching the matches or when ranking the players.

Before leaving, participants were asked to fill out an exit questionnaire to uncover whether each scout (1) knew about the RAE prior to the experiment, and (2) noticed the age-ordered shirt numbering during the experiment.

Data analysis

The *selection bias* of the scouts was assessed by correlating each scout's rank order with the order expected if the players were selected purely on the basis of their age. To do so, players were allocated a number from oldest (number 1) to youngest (number 8). Then for each scout's assessment, we correlated the number order in which the players were selected with the number order expected if the players were selected from oldest to youngest (i.e., a rank order of 1–8). If selections were made purely on the basis of the relative age of the players, then the correlation would equal one; if the players were ranked by scouts in the *opposite* order (youngest to oldest) then the correlation would equal minus one. If the rankings were unrelated to age then the selection bias would equal zero.

To check whether the selection bias differed for Match A and B, we first ran a 2 (Match: A, B) × 3 (Group: no-age, date-of-birth, age-ordered shirt-numbering) ANOVA with selection bias as the dependent variable. Results confirmed that the bias did not differ for the two matches (p = .31, η_p^2 = .05), with no match × group interaction (p = .77, η_p^2 = .02). Therefore, the *mean selection bias* was calculated across both matches for each scout and compared across groups using a one-way ANOVA, with scouting group as the between-groups variable. Significant differences were examined using follow-up t-tests, and planned t-tests determined whether the mean selection bias of each group differed to zero. Significance was set at α = .05. Effect sizes are reported as partial eta squared (η_p^2) or Cohen's d where appropriate.

Results

Significant group differences revealed that the selections made by the scouts changed in response to the information they received about the age of the players (Figure 1;

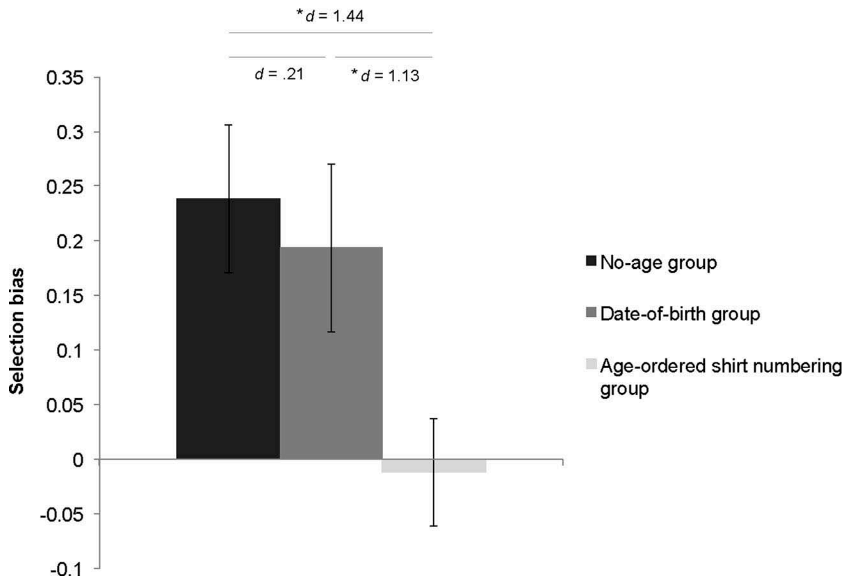

Figure 1. Selection biases induced as a result of the different age information available to the three intervention groups. Error bars show standard error of the mean. Horizontal bars indicate pairwise comparisons and show significant differences between groups (*indicates $P < 0.05$) and Cohen's d for effect sizes.

$F(2,22) = 4.07$, $p = .031$, $\eta_p^2 = .27$). The selections made by the scouts in the no-age group were biased by the relative age of the players ($M \pm SD = 0.24 \pm 0.20$; planned t-test compared to zero, $p = .008$, $d = 1.18$). However, the bias remained for the scouts in the date-of-birth group ($M \pm SD = 0.19 \pm 0.22$; no-age vs. date-of-birth comparison, $p = .63$, $d = 0.21$, planned t-test compared to zero, $p = -.04$, $d = 0.89$). It was only when the scouts were aware of the age-ordered shirt numbering that the selections were no longer biased by the relative age of the players ($M \pm SD = -0.01 \pm 0.14$; planned t-test compared to zero, $p = .82$, $d = 0.09$). The selection bias of the age-ordered shirt-numbering group was significantly less than it was for both the no-age ($p = .013$, $d = 1.44$) and date-of-birth groups ($p = .042$, $d = 1.13$).

Almost all scouts reported awareness of the RAE prior to taking part in the experiment. Only three scouts were not aware of the effect, one from the no-age and two from the date-of-birth group (chi-squared comparison across the three groups χ^2 (2) = 2.38, $p = .30$). Only one scout from the no-age and none from the date-of-birth group reported that they had noticed the age-ordered numbering of the playing shirts during the experiment. That scout who did report noticing the numbering said he did so while watching the second video; however, his response bias during the second match ($r = .52$) was *higher* than for the first match ($r = .02$), so we remain sceptical that he did notice and/or account for the numbering.

Discussion

The aim of this study was to determine whether the selection bias associated with the RAE could be reduced as a result of access to information about the age of junior players. Three groups of talent scouts watched video footage of junior football games and ranked the potential of the players in those games. Crucially, the nature of the information about the age of the players differed across the three groups: a *no-age* group did not know the players' ages, a *date-of-birth group* knew the birthdates of the players, and an *age-ordered shirt numbering group* knew that the shirt numbers corresponded to the relative ages of the players. Results revealed a significant selection bias for scouts in the no-age group, with the bias remaining unchanged for the scouts in the date-of-birth group. However, the selection bias was eliminated when scouts had access to the relative age of the players in the form of age-ordered shirt numbering. The results confirm that the selection bias resulting from the RAE is very pervasive (Cobley et al., 2009), yet can be overcome by the provision of appropriate information about the age of the players being observed.

In this study, we introduced a new measure of bias by correlating the age-order in which the players were selected with that expected if the players were selected on the basis of age alone. The results confirm a significant selection bias as a result of the RAE when scouts select players on the basis of their potential in the game (Cobley et al., 2009), and therefore that relatively older players benefit from an increased likelihood of being identified as a player with potential. The critical finding though is that it *is* possible to reduce the selection bias associated with the RAE, but that it may not be as easy to do so as might have otherwise been expected. It seemed reasonable to presume that talent scouts would take into account the birthdates of players when making selections (e.g., Helsen et al., 2012). If this were to be the case then a significant reduction in selection bias would have been expected for the date-of-birth group who did have access to the birthdates of the players. The clear outcome from our study though was that knowledge of the birthdates did not alter the magnitude of the selection bias: the significant bias found for the scouts in the no-age group remained unchanged for the date-of-birth group. What is most surprising is that the birthdates made no difference even though the scouts *knew* that they were taking part in a study examining the impact of the RAE on talent identification. The robust nature of this effect helps to explain the absence of any reduction in the magnitude of the RAE over recent years (e.g., Helsen et al., 2012).

Crucially, this study offers sport teams and organisations a simple and practical means of reducing the selection bias associated with the RAE in junior sport. When the scouts were aware that the shirt numbering corresponded to the relative ages of the players, the selection bias seen for both the no-age and date-of-birth groups was eliminated. This shows that scouts *are* capable of accounting for the age of players when making selections, but that the likelihood of doing so depends on the manner in which the information about age is conveyed. The age-ordered shirt numbering facilitates two possible advantages: (1) it presents information about relative age in a way that is easy for the scouts to understand (i.e., presenting the explicit order in which the players were born rather than just making birthdates available); and (2) information is available in *real-time* while scouts watch the match (meaning they don't need to look away from the game to see the birthdates and/or commit those dates to memory). At this point, it is not clear which of these differences best accounts for the reduction in the selection bias; further empirical work would be required to isolate the impact of the individual mechanisms underpinning the change.

In this study, we have examined the association between relative age and the selections made by scouts, largely assuming that age is strongly associated with maturation. Equally, we could have measured biological maturity (e.g., by measuring skeletal age, see Malina, 2011; age at peak height velocity, see Mirwald, Baxter-Jones, Bailey, & Beunen, 2002; or percentage of predicted adult height, see Khamis & Roche, 1994; for a discussion see Malina, Rogol, Cumming, Coelho e Silva, & Figueiredo, 2015) to establish how maturity influences selections. Some sporting organisations do measure biological maturity in an attempt to account for it *and* relative age when offering opportunities to young players (e.g., Lansley, 2015; Verseput, 2016), though it remains largely unclear how successful those organisations might be in accounting for that information in their selections. Indeed, the protocol we have used in this study offers an opportunity to examine how relative age and biological maturation interact in influencing the selections of scouts (see Hoare, 2000; Te Wierike, Elferink-Gemser, Tromp, Vaeyens, & Visscher, 2015). In particular, it would help to understand how this interaction changes with age. Indeed the influence of biological maturation may be even larger than that for age during the adolescent growth spurt (13–15 years for boys and 11–13 years for girls, based on age of peak height velocity; Sherar et al., 2010), because some children commence biological maturation earlier than others and so chronological age during the growth spurt may be less indicative of maturation (and therefore less likely to influence selections) than what would be expected before and after the growth spurt. If confirmed then this would advocate the use of shirt numbering during the growth spurt that conveys differences in biological maturation – or a combination of maturation and age – rather than simply displaying differences in age. Finally, the correlational approach used in this study (relating age and selections) offers a promising approach to better understand the *other* personal and performance parameters that influence the judgements of scouts and coaches (e.g., Cumming et al., 2005). Scouting is an inherently subjective process and it remains largely unclear what it is that scouts are looking for in a player (and/or influences their selections) when making judgements of talent. The rankings of scouts could be correlated with other measures of performance (e.g., technical skills, bilaterality, creativity) or personal/anthropometric parameters (e.g., speed, height, intelligence) to better understand the basis on which scouts make their selections, and how this might differ between scouts of different levels of skill or experience.

This study has illustrated the impact of age-ordered numbering on the selections of scouts, but the shirt numbering if used on a more regular basis may also offer a simple and practical means for sport teams and federations to mediate other indirect effects that perpetuate the RAE (e.g., Sherar et al., 2010). First, if the shirt numbering helps to make *coaches* more aware of the age differences of their players then the regular use of age-ordered shirts may help coaches to adapt their coaching to the individual needs of the children. Body size (and by association maturation) is known to lead coaches to provide more positive and supportive instructions to young athletes with favourable maturation (Cumming et al., 2005), and so coaches may be able to lessen this bias if they can better recognise the differences in age/maturation between their players (see Furley & Memmert, 2016). Moreover, it may help coaches to provide more age-appropriate coaching and instructions so that it is tailored to each player's expected skill level based on their age and/or maturation. Second, the age-ordered shirt numbering could even help to make the *individual players* aware of the differences in skill that should be expected as a result of their relative differences in age. In this way, the shirt numbering could make a relatively younger or less-mature player aware that they are younger than the others in their team, and the player could thereby justifiably attribute their lesser skill to their age, helping to minimise the decrease in confidence and/or self-esteem that might be expected when that player is less able to compete with the other (older) players (Dubas, Graber, & Petersen, 1991; Jones & Bayley, 1950). To this end, the effect of age-ordered shirt numbering could be measured by changes in the confidence/self-esteem of younger players, and ultimately by a decrease in the drop-out rate of those children (Helsen et al., 1998; Lemez et al., 2014).

There are some considerations that need to be taken into account to maximise the likely effectiveness of age-ordered shirt numbering. Probably the most important is that the linearity of the numeric progression of the playing shirts could give a false impression of the differences in the age of the players. If, for example, the oldest three players in a match (wearing shirt numbers 1–3) were to be born on the 1st of January, 2nd of January, and 1st of March (for a cut-off date of 1st of January), the linearity of the shirt numbering might give the impression that the player wearing shirt number two is considerably younger than the player wearing shirt number one (whereas they are practically the same age). Similarly, player two would be almost 2 months older than player three, yet the gap might be assumed to be closer. If scouts or coaches were to account for the shirt numbers in their assessment of the players then this would provide the player wearing shirt number two with a considerable advantage over both those wearing numbers one and three. Further work is warranted to assess whether the linear nature of the age-related shirt numbering introduces its own biases in the assessment of players, and whether simple modifications could account for these biases. For instance, certain shirt numbers could be left unworn (e.g., the players in the above example could wear numbers one, two and four, respectively, to provide the impression that player two is closer in age to player one), and/or whether predetermined numbers could be used to indicate a player's birth month or quartile.

Conclusions

Young athletes born later in a selection year are unfairly discriminated against in junior sport, leading to increased dropout and an inequitable level of exposure to coaching and facilities (Cobley et al., 2009; Wattie et al., 2015). This study shows for the first time that the selection bias found as a result of the RAE can be overcome if information about the age of players is conveyed in a suitable way. Simply making scouts aware of the birthdates of the players they observe is insufficient to reduce the selection bias. Rather, the bias can be eliminated by ensuring that the shirt numbers worn by junior athletes during competition are ordered according to their age. This approach offers a promising means of providing a fairer chance of success to those relatively younger players who might otherwise be unfairly (and unwittingly) discriminated against in junior sport.

Acknowledgements

We would like to thank Rini de Groot, Mauro van de Looij, Ruud van Elk, Stan van Bijsterveldt, Bastiaan Riemersma and Luc van Agt for their assistance with the project.

Disclosure statement

No potential conflict of interest was reported by the authors.

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